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New or Emerging Infectious Diseases in Cattle

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INTRODUCTION

Disease is defined as a definite process having a characteristic progression of symptoms that may affect the whole body or any of its parts. Its cause, specific effects, and outcome may or may not be known. Infectious, metabolic, toxic, deficient, genetic and traumatic causes are examples of categories fitting the definition. Infectious processes frequently receive attention due in part to their ability to spread to other animals through various means.

Infectious processes are given "new or emerging" status for various reasons. New or relatively rare entities may become prevalent. Changes in existing infectious disease characteristics have resulted in new clinical signs of disease. Management changes resulting in new risk factor combinations have resulted in new infectious processes under predisposing circumstances. Seasonal severe weather conditions also have resulted in new infectious disease trends.

Completely new infectious agents are infrequently identified in the United States. Foreign animal diseases such as foot and mouth disease are not present in the United States and strict preventive measures are enforced. Surveys evaluating prevalence of known disease-causing organisms in cattle often reveal surprisingly high incidence rates. Presence of disease causing organisms in cattle populations frequently does not imply that disease will occur.

Several infectious diseases have received attention at varying levels recently. Their importance or future implications are often not known.

JOHNE'S DISEASE (Paratuberculosis)

Johne's disease (JD) was first reported from the work of Johne and Frothingham in 1895 and is caused by the bacterium *Mycobacterium paratuberculosis*. It has historically been a disease associated primarily with dairy cattle with prevalence estimates ranging from 2-18%. A Wisconsin study of 159 dairy herds resulted in 34% of the herds testing positive with 7.29% of the 4990 animals tested positive. A Texas study or prevalence of antibody in serum of 1209 beef cattle found 25.2% positive and of 1282 dairy cattle found 13.3% positive. The prevalence over all samples was 19.1%. It is increasingly being recognized clinically in affected beef herds in the United States.

The disease is a slow developing condition which usually is found in adult cattle from 2-8 years of age. However, infection itself usually takes place at a young age. Clinical signs of JD tend to occur at younger ages in herds with heavy rates of infection. Typically only 5-10% of infected animals in a herd show signs of the disease. Infection rates as high as 60% in affected herds have been reported. Chronic diarrhea is the primary clinical sign of JD. Diarrheic cattle suffer severe weight loss, emaciation, and eventually death. There is no effective treatment for the condition. Infected cattle not showing signs have been shown to have impaired productivity in dairies.

Young calves are most susceptible to infection. The major route of transmission is through exposure to contaminated fecal material from an infected dam to its offspring. Infected feces contaminate the teats, hair, and immediate environment of the calf. Transmission to the unborn fetus during gestation is also thought to occur. The bacteria causing JD is also present in the colostrum and milk of infected cows, exposing calves through this route also. Following infection in a young calf, it invades intestinal lining where it multiplies slowly, causing thickening of the intestinal wall and eventual diarrhea years from the time of initial infection.

The disease usually is introduced into a herd by introduction of a normal appearing but infected animal. Feces from infected animals contains high numbers of the infective bacteria.

Diagnosis of JD is accomplished usually by culture of fecal material and/or by serological testing. Histopathology (microscopic examination) of intestinal tissues is also used. Culture is the most specific and sensitive method of detection and can be used for diagnosis in cattle prior to onset of clinical signs and in animal visibly affected. Cultures typically require 12-16 weeks for completion due to the slow growing characteristic of the bacteria. There are advantages and disadvantages of available serum tests that need to be addressed when used in diagnosis and control of the disease. However, they can be very useful.

Beef herds experiencing persistent diarrhea in adult animals are candidates for JD. Typically, individual cattle show signs, with less than 1% of a herd affected in a given year. In herds of unknown status, fecal cultures or a combination of fecal culture and serology appear to be the best diagnostic approach. If a positive case is confirmed, further diagnostic and control measures are indicated. JD is usually a herd disease, with only a small percentage of infected animals showing signs. Infections will persist indefinitely in infected herds.

VESICULAR STOMATITIS

Several states have had confirmed positive cases of vesicular stomatitis (VS) since April, 1995.

Vesicular stomatitis is a viral disease that affects primarily horses, cattle, and swine. However, humans and other animal species may also be affected. The first major known occurrence of the disease was in U.S. military horses during the 1914-18 war. An early outbreak was also reported in Indiana in 1925. The virus is confined to the Western Hemisphere where it affects animals in North, Central, and South America. Historically, the disease has occurred in

cycles at approximately 10 years intervals and in the U.S. has spread from south to north geographically, following river valleys and also the Rocky Mountains. High altitudes and deserts appear to act as barriers to spread.

VS has an incubation period that ranges from 2 to 8 days. It causes blister-like lesions in the mouth that includes the tongue, lips, gums, nostrils, and dental pad. Oral lesions are usually the most commonly found lesion. Blisters also occur on the teats and feet of affected animals. Excessive salivation or drooling is a common sign. Pigs often become lame due to foot lesions. The disease causes a flu-like disease in humans.

Affected animals often refuse to eat or drink and consequently lose weight. Numbers of affected animals in herds vary, with 20-80% rates of infection common. Death loss from uncomplicated VS does not occur. There is no specific treatment for VS other than supportive therapy when needed. Special precautions should be observed when handling infected animals to avoid human infections and to prevent further spread of the disease.

VS is indistinguishable from foot and mouth disease except by laboratory tests. VS is diagnosed by serological and virus identification techniques. Its similarity to foot and mouth disease and other vesicular-type diseases makes its control important in order to prevent and monitor their possible introduction into the U.S.

Transmission of VS is not fully understood but spread by insects, movement of animals, contact with infected animals, and mechanical transmission are all thought to play a role. Fluid from ruptured blisters contains virus from which the disease may be spread. Animals usually recover in about 2 weeks. However, blisters may take up to 2 months to heal and these animals may still spread the disease. Past outbreaks of VS have subsided with the advent of cold weather, although some exceptions have been reported.

Observance of movement restrictions from infected areas of the country is strongly recommended. Many states have imposed restrictions on animals originating from within a 10 mile radius of a positively diagnosed case for a period of 30 days from the last diagnosis. Spread of the disease by movement of infected animals is a problem in outbreak situations.

PROTOZOAL ABORTIONS

Abortions attributed to protozoan infections have become an important cause of pregnancy wastage in cattle. Most reports list the protozoan *Neospora* as the primary agent although other species of protozoans may be involved. *Neospora, Neospora spp*., and *Neospora caninum* as well as others have been described.

The protozoan *Neospora caninum* was first described in dogs in 1988. Reports in cattle followed shortly thereafter. Dairy cattle primarily have been affected but the disease has involved beef cattle as well. The life cycle of *Neospora* is unknown but is thought to be similar to other protozoans such as *Toxoplasma*. In toxoplasmosis, a carnivore host passes oocysts in feces. An intermediate host then consumes these oocysts in contaminated feed or water. The

organisms then cross the placental barrier causing fetal infection. Transplacental transmission of *Neospora caninum* has been confirmed. Initial infection usually involves central nervous and muscle tissues. Presently, the primary host or hosts for this protozoan disease is unknown, making specific control measures difficult.

Clinical signs of the disease involve abortions usually at 3-8 months gestation but concentrated at 5-7 months. Abortions can occur in storms in herds as well as individually. Abortion storms have involved multiple years in some affected dairies. Infected cows that have aborted may abort in subsequent gestations as well. One sign in adult cows, increased salivation, has been reported near the time of pending abortion storm. Another form involves young calves aged from newborn to about 2 weeks of age. These cases calves exhibit limb weakness, usually in the hind limbs, and also related paralysis. Calves born with this neuromuscular condition usually do not survive and are often euthanized.

Diagnoses in beef cattle have been markedly fewer than in dairy cattle. The condition may be less frequent due to the less intensive management conditions under which beef herds are maintained. However, diagnostic submissions from beef herds until recently often have not included proper tissues needed for protozoal abortion diagnosis. The unknown status of this protozoan life cycle leads to uncertainty as to whether this condition has been present for significant periods of time or if it is relatively new to cattle populations.

Diagnosis of protozoal abortions requires microscopic examination and often special staining of tissues. Lesions and protozoal organisms are found in brain, heart, and muscle so submission of these tissues along with other fetal tissues normally submitted in abortion cases is critical for diagnosis. Often, since the protozoans are found in low numbers in fetuses, multiple submissions of aborted calves may be needed to confirm the diagnosis. Serum tests for cows are also becoming available and offer diagnostic assistance where *Neospora caninum* is involved.

Recommendations to control or prevent these abortions are rather limited, especially due to lack of knowledge about the disease. Protection of feed and water from fecal contamination, especially domestic and feral contact, is suggested. There is no known treatment although in some instances there has been limited response in puppies, mice and in laboratory studies. Aborted fetal tissues and membranes should be disposed of to prevent exposure to potential carriers of the disease.

BOVINE VIRAL DIARRHEA VIRUS

Bovine Viral Diarrhea (BVD) is a well known viral disease in beef and dairy cattle. BVD Type II has recently become known as a clinical entity following outbreaks in Canada and in the Eastern U.S. BVD Type II has been identified for over 15 years and has been found in Nebraska earlier also. BVD virus has been divided into two genotypes; Type I and Type II. BVD virus is a single stranded RNA virus and is subject to high mutation rates. This may account for changing severity and changing clinical signs of BVD disease both over time and between outbreaks. There are a number of different strains of both Type I and Type II BVD. Both types have cytopathic and noncytopathic strains in them.

Investigations of recent severe outbreaks, which have occurred mostly in dairy herds, have revealed predisposing factors. In general the herds involved have been unvaccinated or inadequately vaccinated herds. Herd introductions of cattle of unknown vaccination status have been a consistent finding. The single most important factor has been the purchase and introduction of bred dairy heifers as replacements with unknown vaccination history.

Clinical signs have been variable between animals and herds but in general have included the following: high fever (107°F or higher), off feed, runny, red eyes, decreased milk production, occasional diarrhea, hemorrhagic syndrome (thrombocytopenia), respiratory distress, and death. On necropsy, ulcers and erosions in the GI tract are not consistent, pneumonia of variable severity and Peyer's patch depletion are present. Fetal infections occur during gestation and result in abortions, mummified fetuses, stillbirths, weak calves, and persistently infected calves. Diagnosis can be made by conventional methods used for BVD diagnosis.

Management for prevention can reduce risk of severe BVD losses. Vaccines appear effective against Type II BVD. Modified-live vaccines have shown to be effective. Killed virus vaccines, if used, must follow label directions. One dose of killed virus vaccine is not adequate. Two doses of killed virus vaccine plus boosters may be required to provide adequate protection. Limiting cattle movement and isolation of new and sick cattle are also advantageous.

Testing of incoming cattle for persistent BVD infections gives promise for preventing introduction of both Type I and Type II persistent infections. Diagnostic laboratories are now offering microtiter BVD virus isolation tests that are less expensive and are helpful in making herd assessments of persistent carrier status in addition to evaluating potential new herd additions.

It appears more virulent BVD strains are circulating in cattle populations. At present, well designed vaccinations appear to be effective.

CRYPTOSPORIDIUM

Identification of *Cryptosporidium parvum* oocysts from young calves with diarrhea reached high levels during the spring, 1993 calving season. Diagnostic findings from some diagnostic laboratories reported cryptosporidium from about 25% of beef calf diarrhea cases. Diagnostic findings for 1994 and 1995 generally reported much lower incidence with less than 10% incidence common.

The predominant clinical sign is a profuse watery diarrhea. Mixed infections are common in beef calf diarrheas sometimes making assessment of the primary causative agent difficult. *Cryptosporidium parvum* infections are usually complicated by other diarrhea causing agents. However, diarrhea caused by cryptosporidium alone is possible.

This parasite is primarily transmitted by ingestion of infected fecal material, often on teats, udder, and hair of cows. The parasite invades the lining of the intestine and begins to multiply. Shedding of large numbers of oocysts or eggs occurs from 3-12 days in infected calves.

The cysts are immediately infective and can reinfect the same individual animal as well as other animals by fecal contamination.

Cryptosporidium parvum infections have public health significance since the disease is transmissible to other species, including humans. Epidemics in humans from contaminated water supplies have resulted in large numbers of human infections and have raised questions about sources of exposure for some human outbreaks.

A human broad-spectrum aminoglycoside antibiotic, paromomycin, has shown some promise of effectiveness in calves. However, research regarding its use has been prophylactic or preventive. Work documenting effective treatment in calves has not been published. There is one report of the drug clearing oocysts from feces of a cat with severe cryptosporidial diarrhea. Summarizing, there are no approved specific treatments or preventive therapeutics available for cryptosporidium infections in cattle at this time.

ROTAVIRUS DIARRHEA FROM MULTIPLE STRAINS

Neonatal calf diarrhea induced by rotavirus infections alone or mixed with other causes of diarrhea is well known. Studies in recent years have confirmed existence of and disease caused by varying strains of the virus. These variations differ mostly by the type of proteins that cover the capsule or surface of the virus. Immunity is generated by recognition of the surface proteins on the virus by the infected animal, resulting in production of immune protection.

Questions have been raised about how protective immunity may be against all strains. Current studies indicate that crossprotection between strains does exist in some cases and likely does not exist in others. An Ohio State study typing 102 field isolates revealed marked strain variability. This suggests that immunity generated in a herd to rotavirus may not be sufficient if mutation of the virus has produced a new strain or strains or if introduction of new animals has brought in new variants of the virus.

SUMMARY

Management for prevention of disease is key. Knowledge about risk factors that increase or decrease likelihood of disease is critical to the design of effective management plans. Herd introductions increase risk of introducing new disease pathogens. Plans to decrease that risk appear to be prudent. Health security of beef herds can and should be addressed in terms of the economic cycle currently facing the beef industry.

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